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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/773,312	01/31/2001	Guarionex Morales	AMD18366US0 MCF/DBB	2747

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EXAMINER

NGUYEN, HA T

ART UNIT PAPER NUMBER

2812

DATE MAILED: 12/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/773,312

Applicant(s)

MORALES ET AL.

Examiner

Ha T. Nguyen

Art Unit

2812

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 October 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) _____ is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-23,25,29,30 and 48-50 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Notice to applicant

1. Applicants' Amendment and Response to the Office Action mailed 7-17-3 has been entered and made of record.

Response to Amendment

2. In view of arguments and the amendment to the claims, the rejections of claims 1, 3-23, 25, 29, 30, 48-50 under 35 U.S.C. 102 or 103, as stated in the Office Action mailed 7-17-3, have been withdrawn.

Applicants' arguments with regard to the rejections under 35 U.S.C. 102 or 103 have been fully considered, but they are not deemed to be persuasive. The response to these arguments will be incorporated in the new ground of rejection given below.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 20, 21, and 48 are rejected under 35 U.S.C. 102(b) as being anticipated by Akram (USPN 5661334).

Referring to Figs. 4-5 and related text, Akram discloses [Claims 1 and 21] a method for reducing diffusion of dopant ions from a doped dielectric layer into a metal layer, consisting of: depositing directly on said metal layer 41 a single diffusion barrier consisting of a layer of metal nitride, aluminum nitride 11a (see col. 3, lines 25-35 and col.4, lines 31-42); and then depositing a layer of doped dielectric material 18A on said diffusion barrier, wherein said diffusion barrier prevents direct contact of said doped dielectric layer with said metal layer;

[Claim 20] wherein said doped dielectric layer is selected from the group consisting of fluorine doped silicate glass (FSG or SiOF), phosphorous doped silicate glass (PSG), boron doped silicate glass (BSG), and boron phosphorous doped silicate glass (BPSG) (see abstract);

Art Unit: 2812

[Claim 48] Referring to Figs. 6-8 and related text, Akram discloses a method of reducing diffusion of dopant ions from a doped dielectric layer into a metal layer of a device stack having a metal layer 61 or 71, consisting of: forming a trench in said device stack, said trench having at least one sidewall; depositing on the at least one sidewall a single diffusion barrier, wherein said diffusion barrier is a layer of aluminum nitride; and then depositing a layer of doped dielectric material on said diffusion barrier, wherein said diffusion barrier prevents direct contact of said doped dielectric layer with said metal layer (see col. 5, lines 1-17).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103[©] and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 49 and 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram in view of Tsuneoka et al. (USPN 5060050, hereinafter "Tsuneoka").

Akram discloses substantially the limitations of claim 50, as shown above. But Akram does not disclose expressly the diffusion barrier is a layer of TiN. However, the missing limitation is well known in the art because Tsuneoka discloses that Si nitride and TiN are equivalent diffusion barrier (See abstract). A person of ordinary skill is motivated to modify Akram with Tsuneoka to use TiN as barrier layer when TiN is readily available in the

Art Unit: 2812

manufacturing process. Besides, the examiner takes Official Notice that TaN is like TiN a good diffusion barrier.

Therefore, it would have been obvious to combine Akram with Tsuneoka to obtain the invention as specified in claims 49 and 50.

7. Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram in view of Liu et al. (USPN 6080657, hereinafter "Liu").

Akram discloses substantially the limitations of claims 4 and 5, as shown above.

But Akram does not disclose expressly wherein said layer of metal nitride has a thickness in the range of about 10 to about 1000 angstroms or in the range of about 50 to about 350 angstroms.

However, the missing limitations are well known in the art because Liu discloses these features (see col. 3, lines 23-28).

A person of ordinary skill is motivated to modify Akram with Liu to obtain a diffusion barrier of sufficient thickness.

Therefore, it would have been obvious to combine Akram with Liu to obtain the invention as specified in claims 4 and 5.

8. Claims 3 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram in view of Tsuneoka and Liu.

Akram discloses substantially the limitations of claims 3 and 22, as shown above.

But Akram does not disclose expressly the diffusion barrier is a layer of metal oxynitride.

However, the missing limitation is well known in the art because Tsuneoka discloses that Si nitride and TiN are equivalent diffusion barrier (See abstract) and Liu discloses that TiON is a better diffusion barrier than TiN (see col. 3, lines 29-42). In a similar manner when oxygen is substituted by nitrogen, nitrogen rich TiN is more effective diffusion barrier.

A person of ordinary skill is motivated to modify Akram with Tsuneoka and Liu to obtain better diffusion barrier.

Art Unit: 2812

Therefore, it would have been obvious to combine Akram with Tsuneoka and Liu to obtain the invention as specified in claims 3 and 22.

9. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Akram in view of Kwon et al. (USPN 6333260, hereinafter "Kwon").

Akram discloses substantially the limitations of claim 19, as shown above.

But it does not disclose the temperature for depositing the doped dielectric layer.

However, the missing limitation is well known in the art because Kwon discloses that the step of depositing a layer of doped dielectric material is carried out at a deposition temperature in the range of about 350 to 400C (See col. 8, lines 9-21). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a *prima facie* case of obviousness exists (See MPEP 2144.05).

A person of ordinary skill is motivated to modify Akram with Kwon to use an appropriate temperature for depositing the doped dielectric layer.

Therefore, it would have been obvious to combine Akram with Kwon to obtain the invention as specified in claim 19.

10. Claims 6-13, 16-18, 23, and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram, Akram in view of Liu, or Akram in view of Tsuneoka and Liu, as applied above, and (further) in view of Lu et al. (USPN 6365517, hereinafter "Lu ").

Akram, the combined teaching of Akram and Liu, or Akram, Tsuneoka and Liu discloses substantially the limitations of claims 6-13, 16-18, 23, and 25, as shown above.

But it does not disclose expressly the dielectric is a doped dielectric, a barrier layer thickness of 100 angstroms, and the details about the plasma.

However, the missing limitations are well known in the art because Lu discloses [Claim 6] wherein said layer of metal nitride has a thickness of about 100 angstroms (see col. 3, lines 14-16); [Claim 7] wherein said metal nitride is formed using a nitrogen rich radiofrequency (rf) plasma; [Claims 8-10] wherein the radiofrequency plasma is formed using hydrogen and nitrogen gases having a ratio in the range of about 0.1:1 to about 4:1, or 0.5:1 to about 2:1, or about 3:2 ; [Claims 11-13] wherein the rf plasma power is in the range of about 100 Watts to

Art Unit: 2812

about 1000 Watts or about 400 Watts to about 800Watts, or about 750 Watts per 8 inch diameter wafer; [Claims 16-18] wherein the pressure in the plasma chamber is in the range of about 100mTorr to about 50 Torr, or about 1 Torr to about 10 Torr, or about 4 Torr (see col. 2, lines 57-col. 3, lines 16). The combined teaching of Akram or Akram, Tsuneoka, Liu and Lu does not disclose the exact claimed rf power or chamber pressure. However any variation in rf power or chamber pressure in the present claims is obvious in light of the cited art, because the changes in rf power or chamber pressure produce no unexpected function. The routine varying of parameters to produce expected changes are within the ability of one of ordinary skill in the art. Patentability over the prior art will only occur if the parameter variation produces an unexpected result. In re Aller, Lacey and Hall, 105 U.S.P.Q. 233, 235. In re Reese 129 U.S.P.Q. 402, 406. [Claims 23 and 25] The arguments used for the rejection of claims 1, 8-10, 21, and 22 also apply. Liu also discloses the steps of: providing a substrate 10; depositing over said substrate, a metal layer 24 from the group consisting of aluminum, titanium, tantalum and aluminum/tantalum. Lu also discloses a deposition temperature in the range of about 200C to about 450C (see par. bridging col. 2 and col. 3).

A person of ordinary skill is motivated to modify Akram , the combined Akram and Liu, or Akram, Tsuneoka and Liu with Lu to obtain lower cost and better quality barrier layer (see Lu, Summary of the Invention).

Therefore, it would have been obvious to combine Akram , the combined Akram and Liu, or Akram, Tsuneoka and Liu with Lu to obtain the invention as specified in claims 6-13, 16-18, 23, and 25.

11. Claims 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram in view of Lu, as applied above, and further in view of Inoue, US Patent 4976839.

The combined teaching of Akram and Lu discloses substantially the limitations of claims 14 and 15.

But it does not disclose expressly the presence of a noble gas selected from the group consisting of helium, neon, argon, krypton and xenon in the plasma.

However, the missing limitations are well known in the art because Inoue discloses the use of Argon in the reactant gases forming a metal nitride (See col. 6, lines 32-49).

Art Unit: 2812

A person of ordinary skill is motivated to modify Akram and Lu with Inoue to obtain smooth and better controlled fabrication process of the metal nitride.

Therefore, it would have been obvious to combine Akram and Lu with Inoue to obtain the invention as specified in claims 14 and 15 .

12. Claims 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram in view of Applicants' admitted prior art (hereinafter APA).

Akram discloses substantially the limitations of claims 29 and 30, as shown above.

But it does not disclose expressly that metal nitride barrier layer is formed using electromagnetic radiation or nitrogen ion implantation .

However, the missing limitations are well known in the art because APA discloses these features (see par. 0078).

It is within the level of skill of a person of ordinary skill in the art to use a conventional method to perform the same.

Therefore, it would have been obvious to combine Akram with APA to obtain the invention as specified in claims 29 and 30.

Conclusion

13. The prior art relevant to the disclosure of this application and not being used in the rejections.

US Patent 5481490 to Watanabe et al. for teaching the use of a nitride of Al, Si, or Ti as diffusion barrier.

14. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for response to this final action is set to expire THREE MONTHS from the date of this action. In the event a first response is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period

Art Unit: 2812

will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for response expire later than SIX MONTHS from the date of this final action.

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha Nguyen whose telephone number is (703) 308-2706 , after Feb. 3, 2004, the new phone number will be (703) 272-1678. The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week. The telephone number for Wednesday is (703) 560-0528.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Neibling, can be reached on (703) 308-3325. The fax phone number for this Group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.



Ha Nguyen
Primary Examiner
11- 29- 03